CERTIFICATE OF MAILING BY "EXPRESS MAIL"
"EXPRESS MAIL" MAILING LABEL NO. EL 964302799 US
DATE OF DEPOSIT: April 12, 2004
I HEREBY CERTIFY THAT THIS PAPER OR FEE IS BEING DEPOSITED WITH THE UNITED STATES POSTAL SERVICE "EXPRESS MAIL POST OFFICE TO ADDRESSEE" SERVICE UNDER 37 CFR 1.10 ON THE DATE INDICATED ABOVE AND IS ADDRESSED TO THE COMMISSIONER FOR PATENTS, P.O. BOX 1450, ALEXANDRIA, VA 22313-1450.

Marsi Fahraji
TYPED NAME OF PERSON MAILING PAPER OR FEE

Marsi Fahraji
SIGNATURE OF PERSON MAILING PAPER OR FEE

APPLICATION

Of

For

UNITED STATES LETTERS PATENT

On

STRUCTURAL PANEL AND METHOD OF FABRICATION

Docket No. GREENS-46002
Sheets of Drawings: EIGHT

Attorneys
KELLY BAUERSFELD LOWRY & KELLEY, LLP
6320 Canoga Avenue, Suite 1650
Woodland Hills, California 91367

STRUCTURAL PANEL AND METHOD OF FABRICATION

RELATED APPLICATION

This application is a continuation-in-part of U.S. Patent No. 6,718,712, which issued April 13, 2004, which claimed priority from provisional application Serial No. 60/127,224 filed March 31, 1999.

BACKGROUND OF THE INVENTION

The present invention relates generally to construction materials. More particularly, the invention concerns structural panels and methods for their manufacture which employ fillers comprised of solid foamed materials or stabilized organic materials, together with a reinforcing structure comprised of commercially available components, which when assembled and faced with a durable covering provides a building component.

Prefabricated structural building panels are utilized in the construction of structures such as houses and commercial, industrial and institutional buildings. They are also utilized in the construction of non-building structures such as retaining walls, fences, and cisterns. The pre-manufacturing of the panels allows for lower costs and faster construction than available with conventional, in-situ piecemeal construction.

Prefabricated structural panels are typically comprised of a filler medium reinforced with metal lattice structures and surrounded by a metal mesh or cage. A coating, such stucco, air blown cementitious mixtures or the like, is added to complete the building process. While these structural panels have been useful in the construction industry, they have had the disadvantage of being costly and sometimes unavailable in rural areas.

Lightweight plastic materials, including many different types of foamed synthetic resins and expanded plastic foams such as urethanes, polystyrenes, and the like, have a number of properties that are highly desired in building materials for various types of structures such as walls, roofs and the like, and these plastic materials have been the customary filler material utilized in structural panels. However, such materials are manufactured from petrochemical substances and have potential environmental damage issues associated with them. There is also the increasing price of these fillers due to the finite quantity of petroleum resources and their depletion. Additionally, there is the difficulty in obtaining plastic foams in developing countries and remote locations as well as the high cost of shipping to these locations due to plastic foam volume to weight ratio.

Companies which provide structural panels produce their own specialized metal lattice structures and metal meshes having various wire gauges and wire bends which deviate from industry standards. For example, industry standard masonry reinforcement trusses use a zigzag configuration having approximately thirty degree (30°) bends. At least one company produces lattice structures having forty-five (45°) bends for use in their structural panels, a configuration which is more structurally sound but which also increases the cost of the structural panel due to production costs. Typically, such structural panels are limited to only one thickness option. The wire gauges of the wire mesh are often altered at key structural points to reinforce the structural panel. While structurally superior, these designs result in increased expense passed to the end consumer. The design of the structural panel may also be complicated which further increases production costs. For example, the structural panel of U.S. Patent 5,487,248 (incorporated by reference herein) utilizes preformed plastic foamed filler elements which create chambers when brought together for the later insertion of wires, pipes, etc., used within the building. In rural areas and foreign countries many of these specialized

materials are not available and must be shipped, further increasing expense or prohibiting the area from using pre-fabricated structural panels altogether.

Previous methods of fabricating panels with a wire truss structure and a wire face mesh have been made utilizing machines and techniques which resulted in panels being limited in the dimensions of the components employed. This effectively stopped a panel from being an engineered panel in that the fabrication methods and machines were so inflexible in their nature and function that the nature of the machine determined the outcome of the panel. If a different panel was desired, a new machine was needed to make the new panel type or, at least, extensive, time consuming, and costly modifications or re-fabrication of the machine, was required.

The manufacture of all Structural Concrete Insulating Panels (SCIP) to date has involved significant capital investment due to the complexity of the machinery required, or, in the case of low-cost methods, it has been very limited in breadth of capacity in terms of sizes of panels able to be produced. In addition, most methods of production have required high levels of technical skill to operate as well as utility (electrical and water) and other support not readily available in developing nations. Also, all other systems have a linear manufacturing path which results in the entire operation being shut down if any part of it fails.

Accordingly, there is a need for a structural panel that is designed is to overcome the above limitations. There is a further need for SCIP panels that can be manufactured by developing nations as well as inner-city business development. There is an additional need to provide a composite structural concrete panel that avoids or minimizes the above-mentioned problems. There is a further need for a means for manufacturing SCIP panels that is low cost, requires little or no technical skills or experience and minimal utilities. There is a need for a process of constructing panels that avoids the cost of producing a new machine or remodeling an existing machine for each design of panel. There is a additional need for a process of constructing panels that employs a

machine dimensionally adjustable for different panel designs. The present invention fulfills these needs and provides other related advantages.

SUMMARY OF THE INVENTION

The present invention relates to pre-fabricated structural panels which utilize commercially available materials, and a cost-efficient and simple method of construction. Accordingly, the main objective of this invention is a novel and improved structural panel which can be constructed in a wide variety of thicknesses, widths and lengths without dependence on limited source and costly materials.

A method of fabricating a structural panel utilizing commercially available trusses comprising aligning a plurality of fillers with a plurality of trusses in an alternating sequence. The aligned trusses and fillers are pressed to form a panel core. Commercially available wire mesh is overlayed over opposing side surfaces of the panel core and the wire mesh is attached to the trusses by attaching commercially available metal ties to connection points of the wire mesh and trusses to hold the panel core together.

Masonry reinforcement trusses are provided that have two substantially parallel rods interconnected by a wire bent around the rods in a zigzag configuration having approximately 30 bends.

The fillers are comprised of solid foamed material filler. The solid foamed material fillers comprise solid foamed plastic, solid foamed glass, and/or stabilized organic material fillers.

A commercially available lathing member is imbedded within the structural panel. A durable coating is applied to the panel core and attached wire mesh. The bailing wire is tied to the connection points of the of the wire mesh and trusses to hold the panel core together.

Upholstery clamps are clamped to the connection points of the of the wire mesh and trusses to hold the panel core together.

Another method of fabricating a number of structural panels utilizing commercially available trusses comprises the steps of selecting a plurality of trusses. A plurality of fillers are also selected and aligned with the plurality of trusses in an alternating sequence. The aligned trusses and fillers are pressed to form a panel core and a commercially available wire mesh is selected. The wire mesh is overlayed over opposing side surfaces of the panel core and attached to the trusses by attaching commercially available metal ties to connection points of the wire mesh and trusses to hold the panel core together. A durable coating is applied to the panel core and attached wire mesh.

The panel core includes notches. The notches are defined by angled corners of adjacent fillers. The durable coating fills the notches during the applying step.

The aligning step includes the step of adjusting a mechanism for aligning the plurality of fillers with the plurality of trusses. The aligning mechanism includes adjustable arms to hold in position any size truss selected during the selecting step. The mechanism also includes adjustable fingers for holding at least one of the fillers in position during the pressing step.

Other features and advantages of the present invention will become apparent from the following more detailed description, taken in conjunction with the accompanying drawings which illustrate, by way of example, the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings illustrate the invention. In such drawings:

FIGURE 1 is an elevational view of a commercially available truss used in accordance with the present invention;

FIGURE 2 is an elevational view of a panel core having alternating trusses and fillers;

FIGURE 3 is a schematic view illustrating the positioning of a wire mesh adjacent to opposing side surfaces of the panel core of FIG. 2 after compressing the panel core;

FIGURE 4 is a partly fragmented perspective view of a fabricated structural panel embodying the present invention and having a durable coating applied thereto;

FIGURE 5 is a partly fragmented perspective view of another fabricated structural panel embodying the present invention and illustrating the relation of lattice structure, core filler elements, wire mesh, C-ring connectors, durable coating, voids in the core and the shaping of core material at truss contact lines to create thicker concrete and resultant increased structural capacity;

FIGURE 6 is an elevational cross-sectional view of the panel of FIG. 5;

FIGURE 7 is a top plan cross-sectional view of the panel of FIG. 5;

FIGURE 8 is an orthogonal view of an embodiment of a mechanical press machine and a cart that can be quickly and easily adjusted to allow the fabrication of panels as specified by engineering requirements;

FIGURE 9 is an elevational view of the cart of FIG. 8;

FIGURE 10 is a cross-sectional view of the lower portion of the cart of FIG. 8;

FIGURE 11 is a partial orthogonal view of the lower portion of the cart of FIG. 8; and

FIGURES 12 and 13 are flow charts of a structural panel process.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In accordance with the present invention, an exemplary commercially available truss 1 is illustrated in FIG. 1. The truss 1 generally comprises a wire 11 having a series of bends 12 around a pair of mutually spaced apart side rods 13. The rods 13 are laid in parallel fashion along the bends 12 of wire 11 and welded or otherwise attached to the wire 11 to provide a generally planar configuration. The trusses 1 are constructed and sold in varying widths which can be utilized for the creation of different thicknesses of structural panels. Such trusses 1 include commonly available masonry reinforcement trusses and space frame trusses, although other commercially available trusses may be used.

As is common in the industry, center wire 11 is bent in a zigzag configuration to provide strength to the truss. The angle of the bends 12 may be varied depending on structural loading imposed on the panel, for example masonry reinforcement trusses traditionally have approximately either 30° or 60° wire bends as shown in the drawings to form triangles within the trusses 1. Of course, other commercially available trusses may have different angles within the bent wire. The gauge of the side rods 13 and the bent wire 11 may be varied to resist varying loads. For example, a 10 gauge wire may be used for heavier load applications and a 12 gauge wire for lighter load applications. The side rods 13 and the bent wire 11 may be smooth wire or deformed. The use of deformed wire creates greater mechanical adhesion between said wires and a cementitious coating 5 as will be further described.

As shown in FIGS. 2 through 4, a panel core 8 of the structural panel 10 of this invention includes a plurality of elongated filler members 2 in face-to-face contact at surfaces 21 and 22 with the trusses 1 interdigitated with the filler members 2. The plurality of elongated filler members 2 lie in a mutually contiguous arrangement. Between opposed surfaces 21 and 22 of the filler members 2 are alternatingly placed trusses 1 of the type shown in FIG. 1 and

aligned with the filler members 2. Each elongated filler member 2 has opposite side surfaces 23 extending generally normal to said opposed surfaces 21 and 22 as shown in FIG. 2. A rectilinear cross-section is the norm but not necessary. Trapezoidal shapes would allow for the construction of curvilinear panels.

The filler members 2 can be of a solid foamed type, such as solid plastic foamed material or glass foamed material. The elongated filler members 2 may also be made from a variety of organic materials comprising agricultural waste or biomass such as straw or wood chips hammer milled or otherwise broken and added to a stabilizer such as cement. The primary requirement is that the finished organic filler element have sufficient physical strength to be useful over the period of time of manufacture and erection of the panels and resist the stresses of the application of the cementitious covering 5. The stabilizer should prevent the environment, insects, rodents and the like, from eating away or degrading the organic material. The foamed material or stabilized organic material is made into the required shape and dimensions to form a panel core sub-assembly. The organic material filler member 2 can be blown into plastic bags or combined with a polymer and poured, extruded or otherwise formed into free standing members as is known in the art.

The use of an organic filler material in the form of biomass or agricultural waste instead of the plastic filler material of prior art allows for the panels to be made more readily in areas where plastic filler materials are not readily available or cost prohibitive. Wood chip concrete is a common material which could be employed as the filler material, however other organic materials which could be formed in the requisite shape would serve to accomplish the desired panel configuration. Examples include corn stocks, bamboo, kenaf, rice hulls, rice straw, orchard thinnings, grain straw, shredded paper, scrub brush, or any organic fibrous material (i.e., biomass or agricultural waste) which could be formed into the needed shape. The organic filler material can be formed to size or can be formed in panels or blocks of larger sizes for efficiency of manufacture and then cut to size. In addition to utilizing cement as a binder for

the organic material, the use of plastic additives such as recycled PET bottles, the use of recycled tires, the use of asphalts, adhesives or binders generated by the plants under imposed conditions such as steam and pressure, can all be utilized to form the organic material into shapes which can be employed in the fabrication of the structural panels 10.

As shown in FIG. 3, lateral compressive pressure is applied to the layered filler members 2 and trusses 1 by a suitable press 100. Thus, the trusses 1 are sandwiched between the opposed surfaces 21 and 22 of each filler member 2 to form a solid core 8. Preferably, the resultant structure is a plurality of filler members 2 stacked together wherein the opposed surfaces 21 and 22 are held tightly together with the layers of trusses 1 imbedded in surfaces 21 and 22. However, only sufficient pressure to allow for the application of the wire mesh 3 is required. Where less pressure is applied such that the completed panel is not rigid of itself, a straightening rod (not shown) may be temporarily applied in the field, so that sufficient rigidity is available for the application of the coating 5. Having a less rigid core panel 8 can also present some application advantages where curvilinear structures are desired. While the norm is for the press 100 to be a mechanical apparatus, it may be sufficient to have the press be nothing more than hand pressure. The press does not need to be bi-directional. There may be sufficient compression achieved with pressure generated from one side 101 of the stacked members against a fixed surface on the opposite side 102 of the stack.

A wire mesh 3, formed of lateral wires 31 and longitudinal wires 32, is laid against the side surfaces of the pressed core of trusses 1 and filler members 2 and attached to the rods 13 with commercially available metal ties 4, such as upholstery C-clamps, concrete reinforcement wires, or bailing wire cut to an appropriate length. The ties 4 are attached by hand, pliers or other appropriate tools. Alternatively, the wire mesh 4 can be spot-welded to the trusses 1. The wire mesh 3 is preferably applied to both sides of the trusses 1 so that the resulting structural panel contains filler members 2 interdigitated with

trusses 1, with overlays of wire mesh 3 on both sides. The wire mesh 3 can be comprised of a wire netting, such as chicken wire as is commonly used in plastering applications, as well as the pre-manufactured wire netting assemblies such as k-lath. Other commercially available wire meshes 3 may also be used as suits the demands of the structure to be built. These commercially available wire meshes 3 are typically of a single gauge of wire in both the latitudinal 31 and longitudinal 32 directions. In some cases, however, the latitudinal wire 31 will be of one gauge while the longitudinal wire 32 will be of a different gauge.

Commercially available anchoring plugs or lathing members 15 such as metal sheets or furring channels may be added to the structural panel 10, typically within the wire mesh 3, to act as a secure anchor for later attachment of drywall, gypsum board or the like.

As shown in FIGS. 5-7, another structural panel 40 embodying the present invention includes a panel core 42 having a plurality of elongated filler members 44 in face-to-face contact at surfaces 46 and 48 with trusses 50 interdigitated with the filler members 44. The plurality of elongated filler members 44 lie in a mutually contiguous arrangement. Between opposed surfaces 46 and 48 of the filler members 44 are alternatingly placed trusses 1 of the type shown in FIG. 1 and aligned with the filler members 44. Each elongated filler member 44 has opposite side surfaces 50 extending generally normal to said opposed surfaces 46 and 48. A rectilinear cross-section is the norm but not necessary. Trapezoidal shapes would allow for the construction of curvilinear panels.

The filler members 44 can be of a solid foamed type, such as solid plastic foamed material or glass foamed material. The elongated filler members 44 may also be made from a variety of organic materials comprising agricultural waste or biomass such as straw or wood chips hammer milled or otherwise broken and added to a stabilizer such as cement. The primary requirement is that the finished organic filler element have sufficient physical strength to be useful over the period of time of manufacture and erection of the panels and

resist the stresses of the application of a cementitious covering 52. The stabilizer should prevent the environment, insects, rodents and the like, from eating away or degrading the organic material. The foamed material or stabilized organic material is made into the required shape and dimensions to form a panel core sub-assembly. The organic material filler member 44 can be blown into plastic bags or combined with a polymer and poured, extruded or otherwise formed into free standing members as is known in the art.

The filler members 44 include utility chases or voids 54 in the core 42. The voids 54 allow electrical wiring and plumbing piping to be routed through the panels 40. In the alternative, the panel 40 may be produced without the filler members 44.

The material of the core 42 is shaped at truss contact lines 56 (i.e., where the trusses 1 contact the surfaces 46 and 48 of the filler members 44) to create thicker cementitious covering 52 (e.g., concrete) and resultant increased structural capacity. For example, from the top or bottom, the panel 40 includes an octagonal cross-section such that a structural T-section or notch 58 is created on either side of the panel 40 where the filler members 44 meet at the truss contact lines 56; allowing for a greater amount of the cementitious covering 52 to fill the area of the notch 58 and increase the structural capacity of the panel 40. For example, the corners 60 of the filler members 44 are cut at 45 degree angles such that a ninety degree angle is formed in the notch 58 on both sides 50 of the filler members 44 when two adjoining filler members 44 are pressed together to form the notches 58 on either side 50 of the panel 40.

A wire mesh 3, formed of lateral wires 31 and longitudinal wires 32, is laid against the side surfaces of the pressed core of trusses 1 and filler members 44 and attached to the rods 13 with commercially available metal ties 4, such as upholstery C-clamps, concrete reinforcement wires, or bailing wire cut to an appropriate length. The ties 4 are attached by hand, pliers or other appropriate tools. The wire mesh 3 is preferably applied to both sides of the

trusses 1 so that the resulting structural panel 40 contains filler members 44 interdigitated with trusses 1, with overlays of wire mesh 3 on both sides.

In use, the structural panels 10, 40 of this invention are arranged horizontally or vertically, depending on the structural loads being imposed. The structural panel 10, 40 can be employed in the construction of structures by itself or it may be integrated with other building materials. Some examples would be: (1) employ the structural panel 10, 40 in the construction of roofs on masonry or adobe walls; (2) the construction of in-fill walls in steel or concrete post-and-beam framed structures; (3) the construction of floors in the aforementioned construction types; (4) retaining walls; (5) fences; and (6) hardscape features such as tables and benches. By selecting trusses 1 of differing wire 11 or rod 13 gauge, or by changing the gauge of the wires 31 and/or 32 in the wire mesh 3, the strength of the structural panel 10 can be varied. Additionally, multiples of trusses 1 or multiple layers of wire mesh 3 may be used to vary the strength of the structural panel 10.

After the completed structural panel 10, 40 is erected to form the desired structure or building, it is then covered with a cementitious coating 5, 52 resulting in a hard, durable and substantially planar finished surface. The norm is for this coating 5, 52 to be a sand-cement plaster mix but it could be any of the air-placed cementitious materials (shotcrete, gunnite, etc.) or could be an adobe material. Additionally, modern coating materials such as hybrid concretes, glass fiber reinforced concrete, cement-plastic, or foamed concrete materials could all be employed to meet specialized or customized needs. It is also possible to pre-cast the coatings 5, 52 on the structural panels 10, 40 and then erect the pre-coated structural panels. The structural panels 10, 40 can also be used to create an insulating and reinforcing core in form-and-pour concrete or form-and-pour earthen systems.

The components of the structural panel are widely available, even in rural areas or foreign countries, which dramatically reduces the costs associated with the pre-fabricated structural panels. Particularly in third world countries,

organic materials as described above which would otherwise be disposed of can be used in the construction of buildings and other structures.

In addition to being able to create the panel 10, 40, it is desirable to provide flexibility in the process, tools, equipment and machines used to create the panel 10, 40. Flexibility is desirable in terms of truss design, mesh design, erection/installation, variation in the composition of the cementituous skins 5, 52, and the addition to the panel of miscellaneous components to enhance the application of the panel.

For example, one factor in the panel design that a user may desire to accommodate is the design of the truss which may involve a range of truss depths, weights or gauges of the trusses and a range of dimensions in the center to center spacing of the trusses. Another factor desirable design flexibility is a range of filler sizes and materials, a range of weights or shapes of the filler elements, and a range of dimensions in the centering or alignment of the filler elements within the core space of the panel. Still another factor is a range of mesh density dimensions (i.e., the center to center spacing of the longitudinal and/or transversal wires in the mesh) as well as a range of weights, or gauges, of the mesh and a multiplicity of layers of mesh on one, or both, faces of the panel.

The user may also need to accommodate a variety of erection/installation methods where the breadth of such erection and installation includes use as air-placed, cast-in-place, pre-cast, tilt-up, and hand applied cementituous skins. Another desirable accommodation is the available breadth of compositions of cementituous skins where such compositions include a variety of aggregates, fiber reinforcement, and a variety of add mixtures to alter the performance of the cementituous skins. Naturally, the user may need to add miscellaneous components to the panel to enhance the application of the panel, such as anchoring plugs or lathing members to facilitate attachment of surface treatment sheet goods.

FIGS. 8-11 illustrate a wheeled cart 70 and a press 100, in the form of a mechanical press 72, where the cart 70 can be quickly and easily adjusted to allow for the fabrication of panels 10, 40 of varying designs, specifications and components.

The carts 70 are generally manufactured from common light steel shapes (angles, tubes, etc.) and are typically ten feet long but can be linked together to create a twenty foot cart for pressing longer panels 10, 40. Any number of carts 70 may be employed which allows for staging of the panel stacks for faster throughput.

The cart 70 includes at least two pairs of adjustable side arms 74 between which a plurality of fillers 2, 44 with a plurality of trusses 1 are aligned in an alternating, interdigitating, sequence to form a stack to be pressed to form a panel core 8, 42. A first truss 1 is placed along the top of a base 71 of the cart 70 between the side arms 74. A filler member 2, 44 is then placed down on top of the first truss 1 and a second truss 1 is placed on top of the filler member 2, 44. A second filler member 2, 44 can then be placed on top of the second truss 1 and the stacking continued until a desired number of trusses 1 and fillers 2, 44 form a stack of a desired height, and ultimately, a panel 10, 40 of a desired length afer the stack is pressed. The adjustable side arms 74 allow for various widths of panels10, 40 to be manufactured and the registration changed to allow for the adjusting the position of the filler 2, 44 (e.g., foam or bio-mass) 2, 44 in the cart 70 so that the panel core 8, 42 is centered or eccentric (e.g., off-centered), as required since each side arm 74 can be individually adjusted in incremental lengths towards or away from the center of the cart 70.

Once the stack is the desired height, the cart(s) 70 are placed in the press 72 where manual force is employed to compress the stack so as to bring the stack into final height dimension. This results in the core material 2, 44 being compressed and the trusses 1 being pressed into the core material 2, 44. The press 72 includes two vertical poles 62 bolted to the ground, a U-shaped pressing arm 64 pivotally connected to the poles 62, and a pressing bar 66

connected to the pressing arm 64. When the stack is aligned with the press 72, a free-standing elongated plate (not shown) is placed on top of the stack to distribute the force of the pressing bar 66 when the pressing bar 66 is brought down on top of the stack. A plurality of apertures 68 located along the vertical poles 62 allows the height of the pressing arm 64 and pressing bar 66 to be adjusted. The elongated plate is locked into place at the correct final dimension of the pressed stack. Once the elongated plate is locked in place, the cart 70 may be removed from the press 72.

Two ten foot long presses 72 may be arranged side by side in order to allow for each press 72 to be operated independently in pressing panels 10, 40 up to ten feet in length, as well as being operated in concert to press panels 10, 40 over ten feet in length.

The side arms 74 are removable so as to allow free access to the trusses 1 during the panel fabrication process. The same cart 70 can be used to produce panels 10, 40 of various designs, specifications and components and thereby allowing the panels to be an "engineered" product as opposed to being produced on a machine that can only make identical panels. Each side arm 74 includes an inverted U-shaped base 75, vertical member 77, and angled bracing member 79 to brace the vertical member 77. The U-shaped base 75 of each individual of side arm 74 slides along a bar 76 on the base 71 which shaped to receive the U-shaped base 75. Each pair of side arms 74 shares a common bar 76. The arms 74 are adjustable by use of a keeper pin 78 inserted through one of the apertures 73 located on the base 75 of the arm 74 when the aperture 73 is aligned with one of a plurality of holes (not shown) located along the length of the bar 76. The side arms 74 also include adjustable fingers 82 in the form of threaded shafts designed to screw in and out of apertures 84 located along the length of the vertical member 77 of the arm 74. Because each side arm 74 can be individually moved inwardly towards and outwardly away from the center of the cart 70, the change in truss depth and resultant thickness of the panels 10, 40 can be accommodated. Arrows 86, 88 indicate the directions the side arm

74 is adjustable in. The adjustable fingers 82 of the side arms 74 allow the placement of the filler members 2, 44 to be adjustable. In order to make cores 42 with voids 54, the foam filler 44 is cut in a manner that when the two pieces are pulled apart, "split", and off-set by one-half of a cut, the two pieces now form the voids. The adjustable fingers 82 apply pressure to hold the two pieces of foam filler 2, 44 to be held in contact with each other while the panel 10, 40 is being pressed and the face mesh 3 is applied. The fingers 82 also allow the core 8, 42 to be centric or eccentric, thereby accommodating the need for different thicknesses of concrete 5, 52 on the two faces of the panels 10, 40. Were it not for the fingers 82, the core pieces 2, 44 would move away from each other during pressing. Additionally, the adjustable nature of the fingers 82 allows the core 8, 42 to be moved to accommodate dissimilar thicknesses of concrete skins 5, 52.

FIGS. 12 and 13 are flow charts of a structural panel process 200. The process is usually broken down into three portion: design 202, production 204, and erection 206. The first part of the design portion is analyzing the structure to be built (e.g., building, wall, cistern, etc.) 208. The next part is determining 210 the expected structural loads that will be placed upon the structure using standard engineering methods, practices and theories. Once the structural loads are determined, the sizes, weights, strengths, spacing and composition of various panel components can be determined 212 and a panel incorporating those components can be designed to resist the expected structural loads 214. The design can be accomplished through traditional hand calculation and/or employing computer assisted methods. The specification of the components 216 allows engineering (i.e., field erection) drawings to be created 218 and the production portion 204 of the process 200 to start.

The start of the production portion 204 involves ordering the components (e.g., trusses, mesh, foam or bio-mass core, etc.) 220 and the number of panels 222 that need to be produced to build the structure. For example, a particular truss may be selected from a group of trusses more or less

equally suitable for the intended design but with wide variations in the gauges of wires employed and/or the depth, or dimensions, of the fabricated truss. The wire trusses generally have two substantially parallel rods interconnected by a wire bent in a zigzag configuration, as described above, but the wire may be configured (i.e., the dimensions and gauges of the truss wires varied) as needed by the structural load requirements of the panel. In another example, the spacing and gauge of the mesh wire, as well as the number of layers of mesh on one or both faces of the panel, can be varied as needed by the expected structural load and

In an additional example, the fillers may be comprised of foamed plastic, biomass or other suitable material, such as foamed glass, lightweight concrete, foamed concrete, and other composite materials. The fillers can be solid or have hollows or voids such as to facilitate passing electrical conductors, pipes, etc., through the core of the panel. Additionally, the fillers may be routed, melted, or otherwise shaped to form voids that facilitate passing electrical conductors, pipes, etc., through the core of the panel. The fillers can be shaped to accommodate the structural load requirements (e.g., angling the corners of the fillers; thereby increasing the depth of the cementituous skin at the immediate area surrounding the trusses where the fillers are adjacent so as to provide additional functionality such as additional resistance to loads placed upon the panels).

In addition to variation in the size and shape of fillers, the fillers can be positioned within the panel core (centered, off-center with respect to the center of the panel core) as needed by the structural loads placed upon the panel.

The components may be commercially available or specially ordered which requires machines to manufacture the components be set up 224, the components produced 226, and then delivered to the panel fabrication location 118. Once the components are at the panel fabrication location, the panel fabrication machines are set up 230 and the panels produced 232.

In one example, panels can be produced in a three stage process. Hand-pushed carts, such as the one described above in FIGS. 8-11, can be used as the common vehicle through all three stages and assembly tools can be pneumatic or manual "C" ring guns used to attach "upholstery clips" to the metal components of the panels.

The cart 70 is sufficiently adjustable to accommodate the dimensions of the wide variation of components utilized in the fabrication of the panels. The ability of the various portions of the cart 70 to be modified/adjusted to allows the same cart to produce a differently engineered panels, thereby avoiding the cost of producing a new machine or remodeling an existing machine for each design of panel.

For example, the panels 10, 40 are assembled from pre-manufactured components of:

1) filler members 2, 44 including, without limitation, EPS foam blocks cut the size required for the panels 10, 40 or bio-mass tubes of the size required. Typically the foam blocks are six inches wide to accommodate the truss spacing at six inches on center which is the typical configuration;

2) Welded-wire warren trusses 1 of the depth required. The typical configuration is three inches for interior, non-loaded bearing walls and five inches for exterior, load bearing walls and for short-span floors and roofs. Longer spans and heavier loads are accommodated with deeper trusses 1;

3) Welded wire face mesh 3 in the required wire gauge and spacing. The typical configuration is two inches by two inches, twelve gauge mesh for wall panels and one inch by one inch, sixteen gauge mesh for floor and roof panels. The tighter spacing on floors and roofs helps in holding the concrete skin during application in the field.

During the first stage, the panel components are stacked in the carts, ready for pressing in the second stage. As stated above, the carts 70 are typically ten feet long but can be linked together to create a twenty foot cart for

pressing longer panels 10, 40. Any number of carts may be employed which allows for staging of the panel stacks for faster throughput.

The carts 70 have adjustable side arms 74 which allow for various widths of panels10, 40 to be manufactured and the registration changed to allow for the foam or bio-mass cores 2, 44 to be centered or eccentric (e.g., off-centered), as required.

During the second stage, the carts are placed in the press 100 where either manual force or pneumatic or hydraulic pressure devices are employed to compress the stacks in the carts so as to bring the stack into final height dimension. This results in the core material being compressed and the trusses being pressed into the core material. While in the press 100, the top plate of the cart is locked into place at the correct final dimension. Once the top plate is locked in place the cart may be removed from the press and moved to the third stage.

The press is made up of two ten foot long presses 100, arranged side by side. This allows for each press 100 to be operated independently in pressing panels up to ten feet in length, as well as being operated in concert to press panels over ten feet in length.

During the third stage, the welded-wire face mesh is applied and affixed with "C" rings. One or more layers of mesh are overlaid on the opposing faces of the panel and attached to the trusses, to hold the panel core together after the pressure placed on the panel by the press is released.

When the carts arrive at the third stage, the side arms are removed allowing free access to the truss cords. The mesh is placed against the truss cords and affixed to them with the "C" rings. Once the "C rings have been installed the top plate can be released and the panel removed from the cart. The pressure of the core material pressing against the trusses and the face mesh affixed to the truss cords results in a taut and easily handled panel.

The empty cart with its side arms and top plate are returned to the first stage to repeat the cycle. The same cart can be used to produce panels of

various designs, specifications and components. To this end, the physical structure of the cart itself is adjusted to accommodate a panel design different from the previous panel design; allowing changes in panel design to occur as part of normal operation of the cart and not requiring the cart to be remodeled or the fabrication of a new cart to accommodate the new panel design.

This cart would be suitable for fabrication of panels in both fixed locations, as on a factory floor, as well as on a transportable surface, such as a trailer bed. Such a cart could be readily installed on-site for temporary, project-specific, fabrication of panels.

Once the desired number of panels are produced, the panels are delivered to the panel erection location 234 where the third portion (i.e., the panel erection portion) 206 of the process 200 occurs.

During the panel erection portion 206 , the panels are laid out 236 and erected 238 in the designed configuration. Once in position, the panels are prepared to receive a cementitious skin or coating 240. A variety of methods are used in the application of the cementituous skins 5, 52 including, without limitation, air-placed, cast-in-place, pre-cast, tilt-up, and hand applied techniques. The cementituous coating 5, 52 can vary in thickness and strength and composition as needed by the structural load requirements.

Allied or companion materials (e.g., electrical wiring/cabling, plumbing, etc.) are then installed 242 in the panels and the cementitious skin is applied 244 to the panels. Once the cementitious skin is applied, the cementitious skins are finished with decorative surface treatments (e.g., paint, textures, etc.) 246 that are applied to the panels using a variety of processes and methods including, without limitation, form-finished, as-placed, trowel-finished, textured, painted, and all other generally available techniques for finishing concrete, decorative concrete and plaster.

The process is completed 248 when the structural design is complete.

Although several embodiments have been described in detail for purposes of illustration, various modifications may be made without departing from the scope and spirit of the invention. Accordingly, the invention is not to be limited, except as by the appended claims.